Matt Crawford
Amitoj Singh
Adam Walters
Jason Allen
Wednesday, June 15, 2011

PRELIMINARY ACTION PLAN FOR GCC CRB COOLING

This is a report of work still in progress, to aid in decisions concerning high-heat conditions that may arise in the next couple of weeks. The associated ITIL Problem Investigation is PBI000000000256.

The nature of the problem

GCC Computer Room B's total power is, and has always been, significantly below its designed maximum, and below the rating of the CRACs. When at least 9 out of the 10 CRACs are operating, they should be able to remove 945 kW of heat. The room is intended to operate up to 900 kW of computing, and has been at 700 kW in recent months. (It was around 600 kW in the summer of 2010.)

Without short-cutting the root cause analysis, we can say that the difficulties appear to center on the condensers and the circumstances they operate under. In the worst weather conditions, they may not be getting enough air to fully condense the coolant sent by the CRACs. There are notes and photos attached to the PBI in Remedy to explain this more fully, and CD DocDB Document 4359 gives a background on our experience with cooling CRB.

Once the condensers start returning a liquid/gas mixture, effectiveness of the cooling system falls, the compressors in the CRACs run harder, but the room temperature rises only slightly until one or more CRACs fail outright, or give the "HIGH HEAD" alarm (signaling high pressure at the coolant return) and their compressors stop. Then the room temperature rises rapidly and CRAC failures accelerate.

Shedding heat load

Jason and several stakeholder representatives prepared a staged power reduction plan. The first stage involves reducing power by about 30%, shutting down mostly older-vintage systems in racks 3000-3027. (Four racks in 3000-3013 would remain up in this stage, for reasons explained in the PBI Work Info.) We have considered a possible second stage of power reduction by another 20 to 30%. However, we strongly doubt that a second stage would prevent a cooling failure if the first reduction does not. The final stage, of course, is shutting off all computing equipment.

Invoking the load-shed plan

Adam has compared last summer's cooling incidents to Fermilab weather records. The preliminary conclusion is that three factors combine to cause cooling failures:

- Outside temperature above 88°F, especially for consecutive days,
- High solar radiation,
- Low wind.

As of Wednesday morning, June 15, these conditions were not in the local forecast for the next ten days. But as of 1 PM June 15, the forecast for Monday, June 20 changed 93° with partial cloud cover.

We believe that waiting until the hottest part of the day to reduce the heat load is risky. Once multiple CRAC compressors are running at 75 to 100% of capacity, the room may already be in imminent danger of cooling failure. Reducing the load mid-morning when adverse conditions are expected is safer, but of course has a greater impact on computing throughput and a risk of a false preventive action. Invoking the plan in the morning allows orderly communication through the Service desk. System managers can then shut down their designated machines remotely. If load reduction happens in the afternoon, implementation may have to be rushed, even to the point of turning off power at the electrical panels.

We've only begun to think about when to restore normal operations when dangerous conditions have passed.

There are several long-term measures under consideration to improve the operational conditions of the condensers.